

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Environmental & Water
Resources

07/2005



EVALUATION OF THE EMISSION, TRANSPORT, AND DEPOSITION OF MERCURY, ARSENIC, AND FINE PARTICULATE MATTER FROM COAL-BASED POWER PLANTS IN THE OHIO RIVER VALLEY REGION

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PARTNERS

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Advanced Technology Systems, Inc.

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Atmospheric and Environmental Research, Inc.

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Description

Objective

The overall project objective is to quantitatively evaluate the emission, transport, and deposition of mercury, fine particulate matter (PM), and air toxics (arsenic) from coal power plants in the Ohio River Valley region. Ohio University, in collaboration with CONSOL Energy, Advanced Technology Systems, Inc. (ATS) and Atmospheric Environmental Research, Inc. (AER) as subcontractors will conduct the work. First, an existing air monitoring site in Athens, OH will be upgraded to provide the capability to monitor PM_{2.5} chemical composition, species of gaseous mercury in ambient air, and mercury in precipitation. Regional modeling studies will be conducted to develop a comprehensive budget of arsenic, elemental mercury (Hg⁰), reactive gaseous mercury (RGM), and fine particulate matter including sources, sinks, atmospheric lifetimes, burdens, and advective fluxes across the Ohio Valley Region. Updated emissions inventories for mercury and arsenic within the region will be developed to support this objective. Short-term and seasonal simulations with the refined model will be compared to field measurements from the monitoring site and the results will be used to develop a decision-support tool.

Background

The U.S. Department of Energy's National Energy Technology Laboratory (NETL) has established an aggressive research initiative to address the technical and scientific issues surrounding the impact of coal-based power systems on ambient levels of fine particulate matter, NOx, mercury/air toxics, and acid gases. Regulatory drivers such as the 1990 Clean Air Act, the 1997 revised National Ambient Air Quality Standards, and the 2004 proposed Clean Air Interstate Rule (CAIR) and Clean Air Mercury Rule (CAMR) are pushing coal-based systems to multi-pollutant control options. The overall goal of NETL's research effort is to ensure that the best science and technology are available for regulatory decision making related to the health and environmental impacts of ambient fine particulate matter, regional haze, and air toxics.

Summary

The scope of work for the ambient air monitoring includes the deployment of a surface air monitoring (SAM) station in Athens, Ohio. The SAM station contains sampling equipment to collect and measure mercury (including speciated forms of

COST

Total Project Value
\$1,584,052

DOE/Non-DOE Share
\$1,260,777 / \$323,275

PERIOD OF PERFORMANCE

April 2003 to
January 2006

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mercury and wet and dry deposited mercury), arsenic, PM mass, PM composition, and gaseous criteria pollutants (CO, NO_x, SO₂, O₃, etc.). Laboratory analysis of time-integrated samples is being used to obtain chemical speciation of ambient PM composition and mercury in precipitation. Near-real-time measurements are being made of PM mass and pollutant gases including Hg⁰ and RGM. Approximately 18 months of field data will be collected at the SAM site to validate the proposed regional model simulations for episodic and seasonal model runs. The ambient air quality data will also provide qualitative information on PM and gas composition that can be used by Ohio Valley industries to assess performance of multi-pollutant control systems.

Accomplishments

- Beginning in March 2004, operated a surface air monitoring station in Athens, Ohio to collect and measure mercury, arsenic, PM_{2.5}, pollutant gases, and weather data. See "Elemental Hg Trend" in figure below.
- Conducted a one-year base case simulation for the year 1996 with the 3-D chemical transport model
- Initiated meteorological simulations for 2004 base case simulation
- Performed short-term photochemical modeling simulations during July for the year 2001 and compared model predictions to observations from the DOE-sponsored Pittsburgh Air Quality Study
- Refined/updated mercury and arsenic emission inventories for 2004
- Presented a project overview at a key national aerosol conference

Planned Activities

Activities continue to focus on two important tasks. First, seasonal-scale simulations will continue to identify significant sources and source regions contributing to the deposition of mercury and ambient concentrations of arsenic and fine particulate matter over time periods of several months or more. The modeling will also examine the efficacy of emission reduction strategies specifically for coal-fired power plants. Second, web-based model interface technologies will continue to be developed to provide industry and government agencies with a user-friendly decision-support tool to facilitate the evaluation of source-receptor relationships and the efficacy of emission reduction strategies.

Issues

Mercury, arsenic, and associated fine particulate matter can be transported over large distances due to their minimal rate of atmospheric deposition. Elemental mercury transport must be considered a global problem because it is believed to have a half-life of approximately one year in the atmosphere, and little is known about its cyclic transport between land, water, and air. Also, biogenic contributions, particularly those that involve plant respiration, are understood even less well. As a consequence, a regional-scale approach must be adopted in order to adequately evaluate source-receptor relationships for mercury, arsenic, and associated fine particulate matter.

